

Same Level Integration of Dual Thickness and Pitch Metal

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ABSTRACT

A novel technique has been introduced to combine thick, large pitch metal lines with fine pitch, high density lines on the same level in a multi-level integrated circuit design. The process flow of choice decreases processing time on expensive PVD sputter machines by depositing two metal layers at the same time. The Applied materials Endura system is used to deposit a thin(6750 Å) AlCu metal 2 layer followed directly by a TiW etch stop layer and a thick(18000 Å) AlCu metal 3 layer. The Metal 3 is patterned using Cannon I-line Steppers and anisotropically dry etched in an AME 8330 dry etcher prior to the Metal 2 layer below it. A subsequent dry Metal 2 etch in a LAM 9600 achieves the fine pitch requirements as well as finishing the definition of the thick(2.675 µm total) M2/M3 "Bus" lines necessary to carry high current at low resistance. The alternative process flow included a wet metal etch of Metal 3. This process is less preferable because of process control issues including high undercut and non-uniform etch rate. No inter-metal dielectric and associated via steps are required using this technique, which significantly reduces fabrication costs. Preliminary results show feasibility at critical steps. These results include a proven ability to pattern Metal 2 after Metal 3 has been etched. Also, the anisotropic Metal 2 etch is distinguished by sufficiently high selectivity to photoresist such that resist erosion over the thick Metal 3 lines is not an issue.

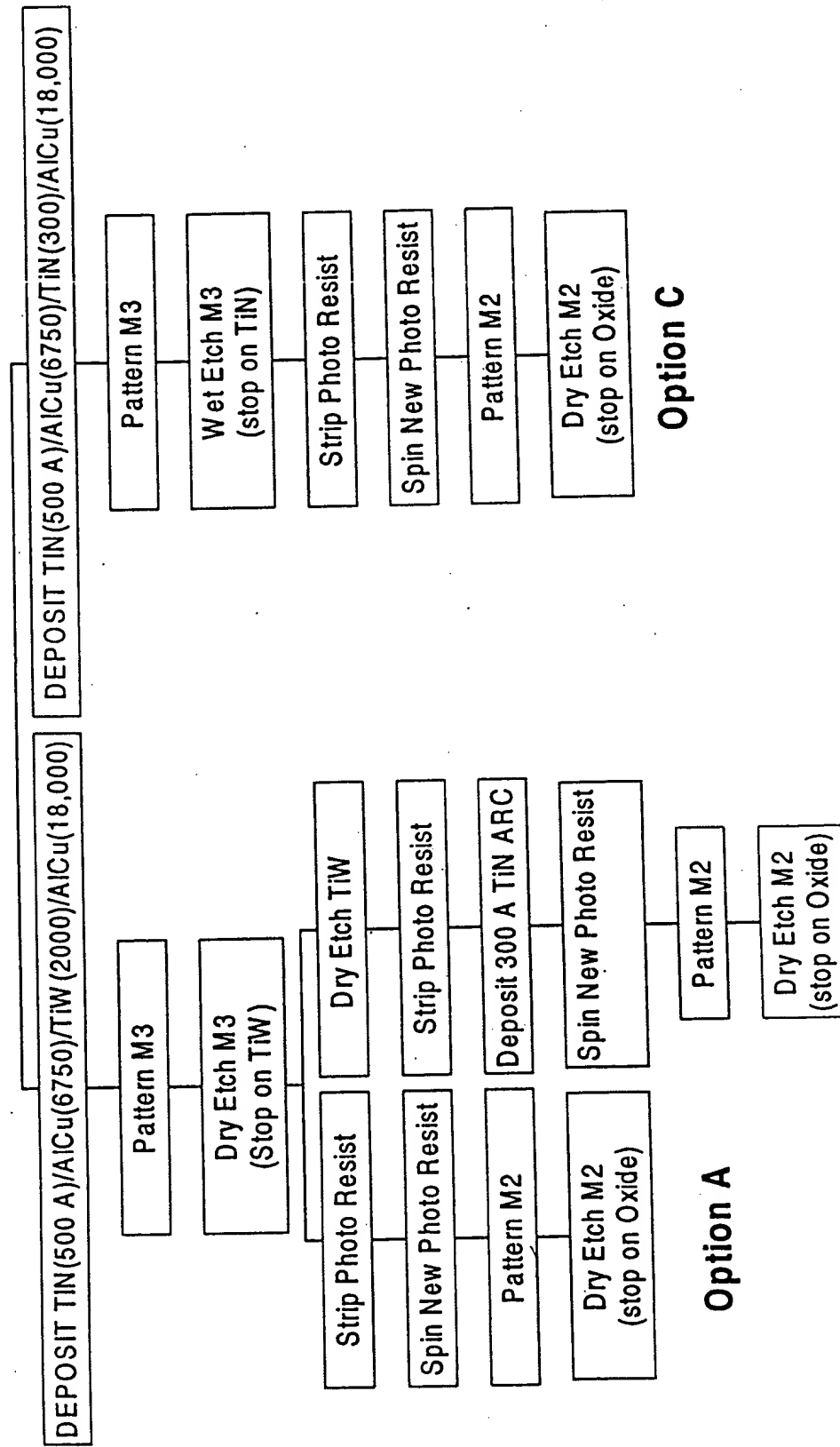
Paper presented at the Thin Film Users Group, California Chapter, October 1997

OBJECTIVE

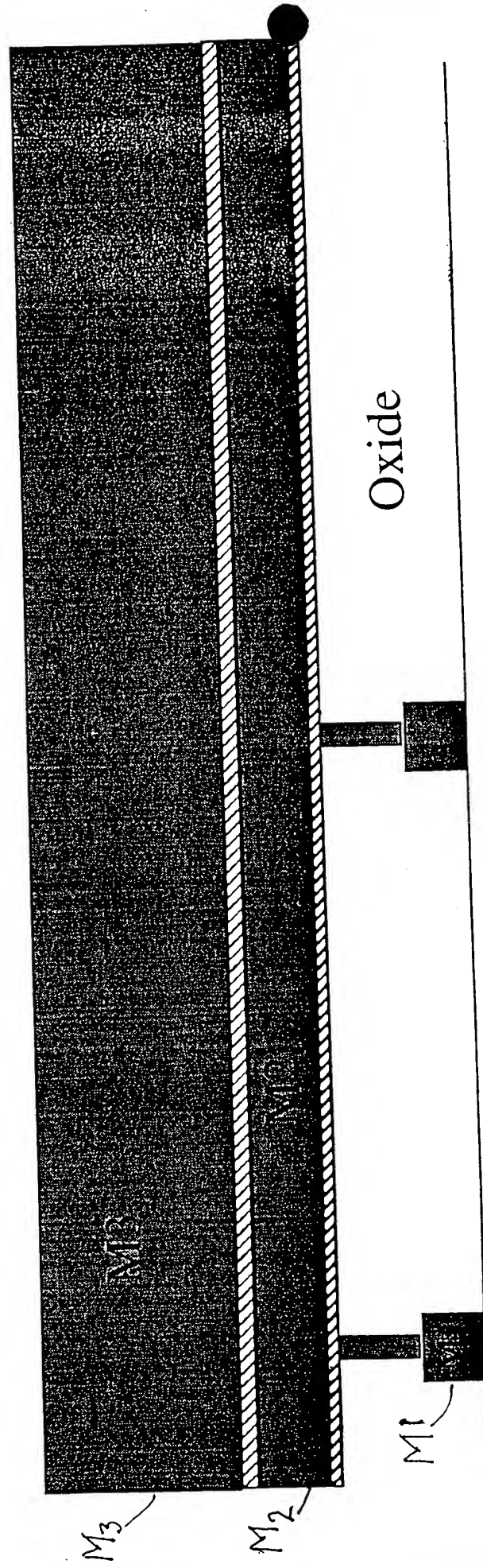
- High current carrying bus lines(M3) on the same level as fine pitch routing lines(M2) with reduced manufacturing costs

	Width	Space	Thk
• Bus Lines(M2/M3)	10um	5um	2.7um
• Fine Pitch Routing(M2)	1 um	1um	0.7 um

Process Flow for Different Options

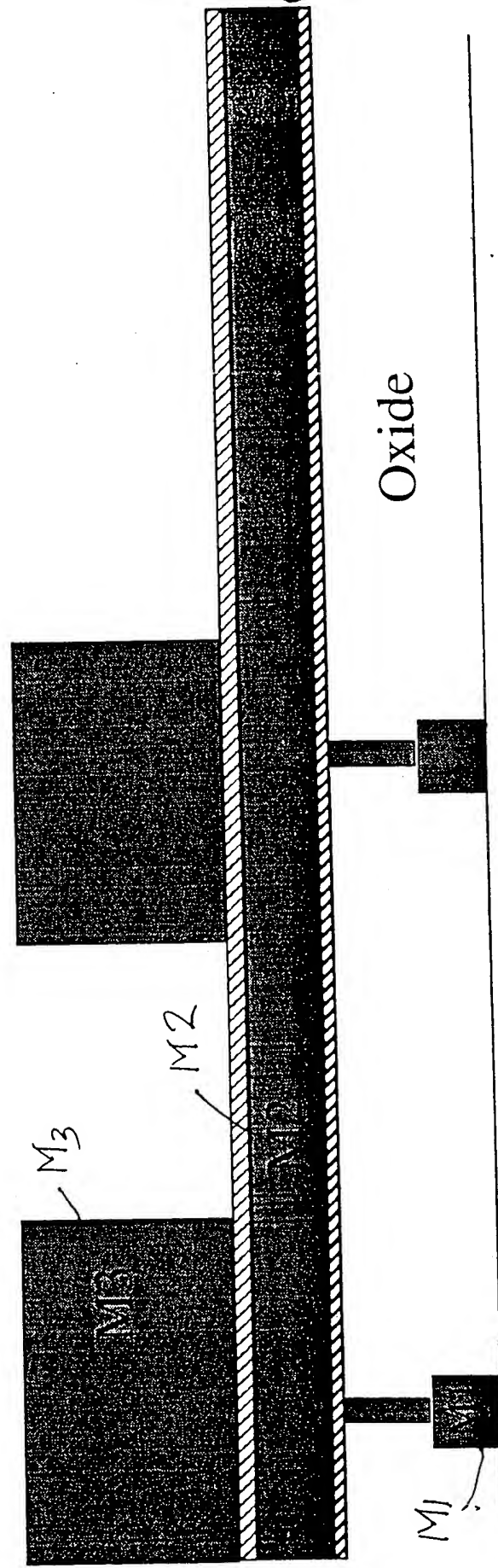


Step 1
Two Al metal stacks are deposited at the same time separated with a TiW Etch stop.
The stacks consist of 1.8 μm and 6750 \AA of Al for M3 and M2, respectively. 2000 \AA of TiW is used



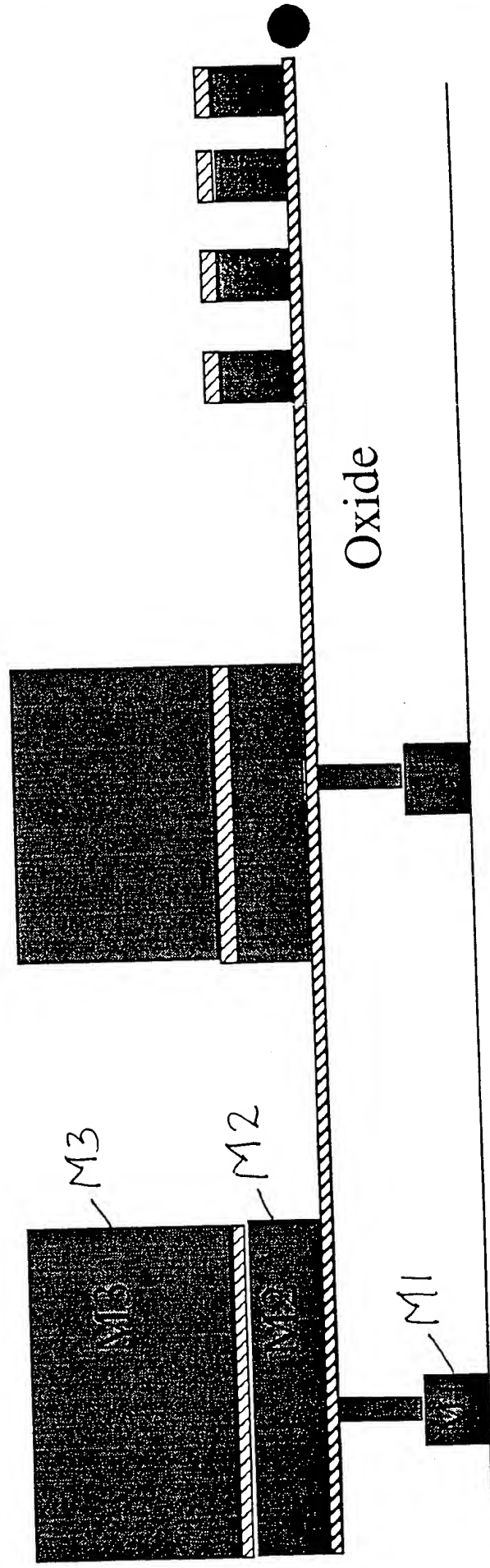
Step 2

M3 is patterned and etched first, stopping on the TiW. M2 is then patterned with thick(2.5 um) resist and etched.

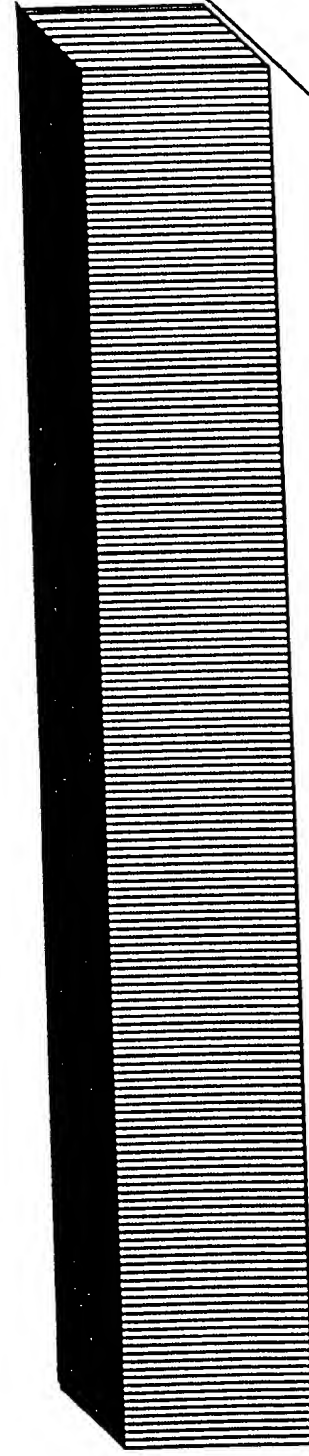
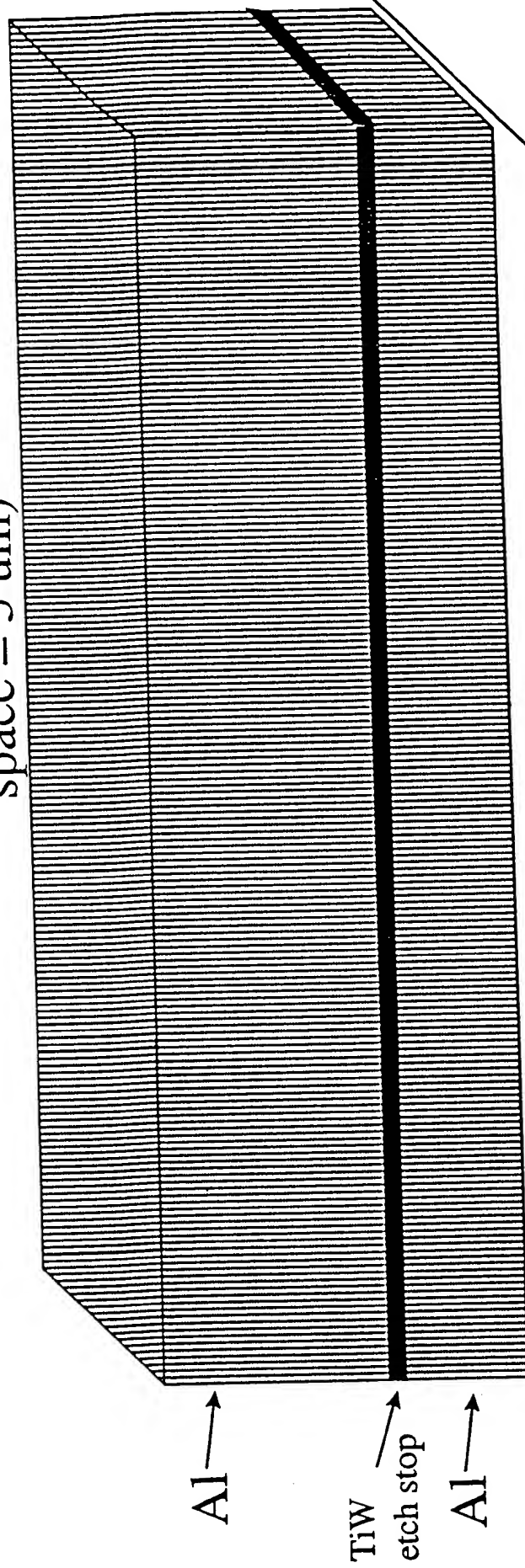


Step 3

The result is a combination of thick M2/M3 "bus" lines and thin, fine pitch M2 lines on the same surface.



M2/M3(thick = 2.675 μm , $W = 10 \mu\text{m}$
space = 5 μm)



M2(thick = 0.675 μm , $w = 1.0 \mu\text{m}$
space = 1.0)

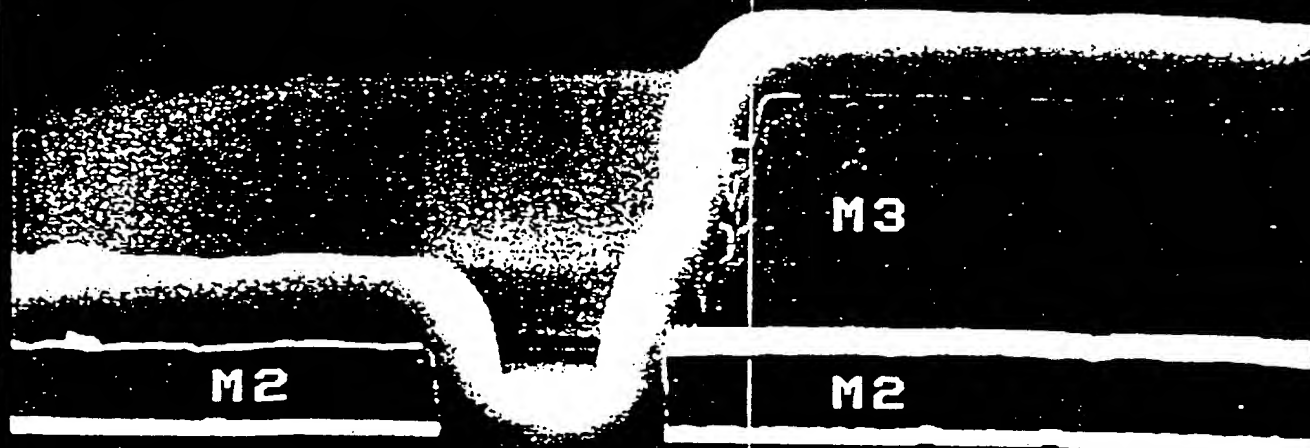
IMO

CONCLUSION

- Process to combine dual thickness metal lines on the same level demonstrated
- Wet and dry etch processes for defining large pitch, thick metal lines investigated.
- Dry metal etch eliminates undercut and line width control issues seen with wet etch.

WD5
05757
BCC

WF#15



000270 10.0kV X10.0K 3.00um

OPTION A

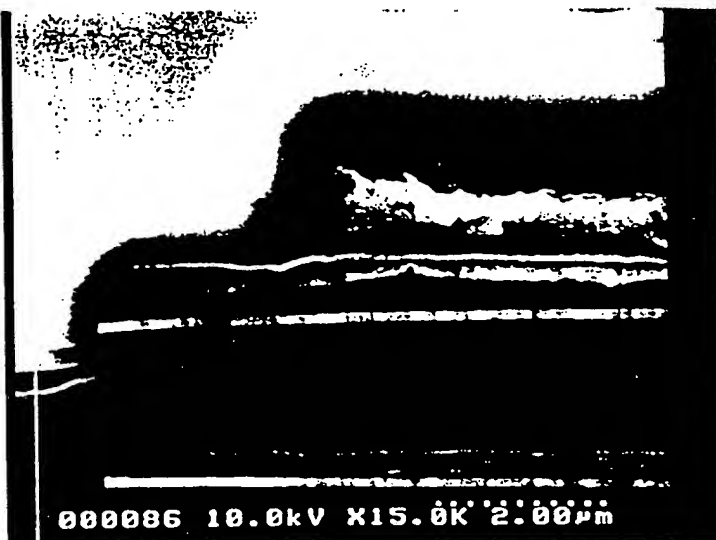
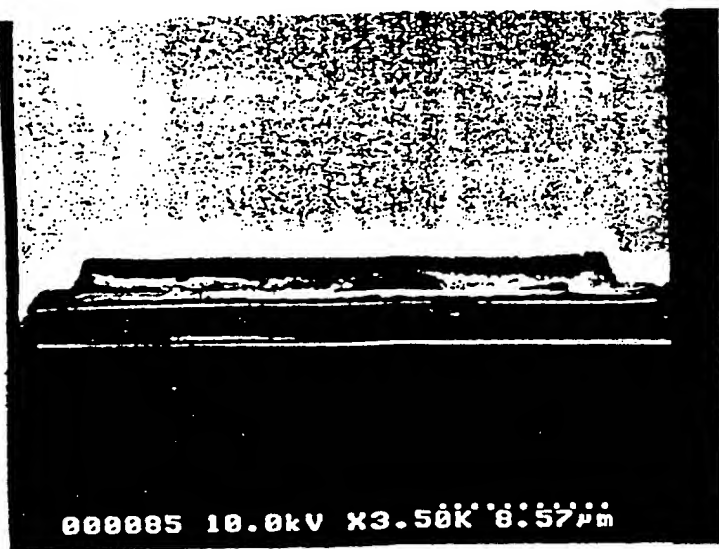
WD5
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WF- 18



000098 10.0kV X10.0K 3.00um

OPTION B



OPTION C